

ANNEX A

USE OF SCIENCE AND EVIDENCE IN AQUACULTURE CONSENTING AND THE SUSTAINABLE DEVELOPMENT OF SCOTTISH AQUACULTURE

SUMMARY OF POINTS RAISED BY STAKEHOLDERS DURING THE ROUNDTABLE

1. What do you think is the main contribution of aquaculture for the benefit of Scottish society?

- Instead of considering benefits of aquaculture, natural capital accounting should look at overall benefits and costs.
- A number of references to benefits to fragile rural local communities, creating a skilled workforce, career and employment opportunities and revenues. Diversifying available work and addressing depopulation and 'brain drain'. Improvements to local infrastructure incl. e.g. provision of defibrillators, local sponsorship. Local amenities supported by people employed by aquaculture (schools, pubs etc). Provides year-round, not just seasonal work. Sector representatives noted positive feedback from communities where they operate.
- Overall contribution of aquaculture to tax revenues and exports.
- Recognition that aquaculture does not rely on local laird and landowners.
- Also noting jobs and upskilling across supply chain having impact across Scotland. Aquaculture academia is also valued globally.
- Food security and nutrition were raised across groups as benefits, relieving pressures elsewhere (freshwater & other wild fish populations, other food production). Aquaculture was noted to produce food with a smaller impact (e.g. lower pesticide use) than some types of terrestrial agriculture.
- Discussions around the tourism economy also important to rural and island economies and noted that there is perception that aquaculture can have negative impact (e.g. wild swimming, visual impacts) – does evidence base support impact?
- Discussions around 'spatial squeeze' on marine users – it was noted that aquaculture uses 0.7% of total sea bed of Scottish inshore waters. Space it takes up is overstated.
- Discussion around using word 'value' in attribution to aquaculture and the longevity of the industry. Discussion around business viability and resilience in supply chain is needed – don't want communities left with 'detritus' of industry. Others noted longevity of aquaculture industry – farms have been working for decades.

2. What do you consider to be the main environmental risks of aquaculture?

Risks/ relevant issues raised by participants included:

- Impacts to sensitive seabed habitats and features (e.g. merl) / benthic impacts.
- Cumulative impacts of aquaculture alongside other marine developments.
- Interacting impacts of climate change and other changes in environment – can affect how chemicals and pathogens behave in the environment.
- Sustainability of fish feed production – sourcing of feed, impact on wild capture fisheries and methods used for this e.g. trawling. Noted that balance of 'fish in – fish out' should be confirmed and agreed on.

- Plastics, packaging, waste materials, microplastics emitted.
- Interactions with wild salmonids including sea lice, escapes & introgression reducing fitness of offspring, transfer of disease.
- Impacts on freshwater pearl mussels.
- Transport, logistics
- Carbon footprint & global impacts.
- Use of unregulated medicines and chemicals (e.g. Hydrogen peroxide). Concerns of sea-lice chemical impacts on shellfish fisheries. Licences allow discharge – despite dilution there is still input of chemicals into sea. One discussion highlighted disagreement in scale of issue of antibiotic use in aquaculture – Some pointed to increasing use, but others noted that salmon farming has low rate of use compared to other farming sectors.
- Excess nutrients resulting in algal blooms
- Issues surrounding cleaner fish.
- Noted not all forms of aquaculture have the same impact e.g. seaweed (and similarly shellfish). Impact from seaweed cultivation is space. Fewer issues with disease. Seaweed can sequester nutrients so provide ecosystem service.

Discussion points

- Note some issues (e.g. impacts on seabed) are improving with monitoring and modelling, ultimately improving spatial planning.
- Key concerns related to interplay between residence time of environmental systems and inputs from aquaculture.
- Each body and sector has its own risks they are concerned with (e.g. wild fisheries → sea lice and escapes).
- Environmental risk and impact is not binary. The split is dynamic and takes place on a gradient, and there can be cumulative risks.
- Can be challenging to predict risk because of availability of evidence (e.g. wild fish interaction). However improvements mean we better understand cumulative impacts.
- Important distinction between environmental risk and hazard – Hazard is acceptance that there is concern, but risk is quantified. Noted that using terms interchangeably is problematic. What is ‘significant’ in terms of risk?
- Risk and hazard consideration should be driven by data, not deeply-held beliefs. Should let go of beliefs if not supported by facts or data.
- Regulatory framework should be clearer about how science is used to safeguard environments – discussions noted existing controls are highly rigorous around e.g. benthic impact, and an international comparison shows Scottish regulation as relatively robust. Role for regulator in communication to gain public trust – frameworks are opaque to general public due to complexity.
- Trust in regulatory frameworks is needed as they are complex, but this is lost if regulators are not enforcing compliance. Process of reporting and enforcing is not clear – NGO contributors felt they had to deduce answers from available data. Lack of transparency can lead to mistrust and misunderstanding.
- Discussion around ongoing changes in regulatory systems – old system noted as inadequate, not fit for purpose. Expertise lacking in parts for such complex system.

Some concern raised around proposed changes. Others note that while current system is complex, it doesn't mean it is not stringent. Lack of clarity doesn't reflect lack of control. Complexity doesn't make it easier to comply with.

- Question raised around relevance of early discussions and controls due to rapid changes by sector. Suggestion there should be a review of environmental risks of fish farming taking into account recent changes.
- As sea-lice is a key issue and impact for industry the principles behind new SEPA sea-lice framework should be supported. There should be further opportunities to create open data sources and collaboration with regulator, industry and government.
- Need to balance environmental risk with economic value. Sustainable industry needs to protect underlying marine environment.
- Some issues location-specific – makes generalisation difficult.
- Science and evidence is nuanced and there is a continuum of debate playing out. A query was raised as to how the Government deals with that and moves relationships into a respectful and collaborative space. It was noted that time and resources are in short supply and that collaboration provided a way to move forward.

3. What do you see as priority natural science research/data gaps that need more work?

Suggested research/ data gaps

- Modelling and machine learning could enhance technology and impact evidence base, particularly for priority marine features.
- Cumulative impact – considering contribution of multiple farms, wider activities in surrounding area. Geospatial, biophysical and socio-economic. Using an ecosystem-based approach to influence decisions e.g. looking at discreet water body. Agreement this should include terrestrial land use influence. Example of Tasmania's ecosystem-based monitoring programme, funded by industry, carried out by EPA and informing / reassuring public.
- Need to take a holistic look at coastal areas.
- Understand impact of growing seaweed sector.
- Better hydrodynamic models – required for long term sustainability of sector.
- Research on sea-lice including infestation of smolts at sea, to improve understanding of risk to migrating salmon, sea lice dispersal and behaviours to better understand interactions. Better understanding of their distribution e.g. through eDNA techniques to help calibrate models.
- Research on enhancing scalability and env impact of big farms.
- Some data gaps being addressed, e.g. west coast tracking project tracking smolt runs. Need better understanding of that combined with lice dispersal and connectivity.
- Sea-trout migration to understand potential longer term impacts on individual and population fitness – including how sea trout explore freshwater.
- Better understanding of baseline status. What are 'normal' conditions? E.g. dissolved oxygen, zooplankton. Who should organise and pay? Control sites for studying effects of sea-lice suggested.
- Potential impacts on baseline water temperature and chemistry around farms on fish health - .e.g around big industrial areas, sewage works - including semi-lethal impacts (noting results of Chemical Investigations Programme).

- Discussion around reassessment of farms within conservation measures areas and MPAs, where established before they were in place.
- Work required on how to update science relating to Environmental Quality Standards and managing process in wider context.
- Toxic effects of chemicals used by farms (e.g. Hydrogen peroxide) & Impacts of algal and jellyfish blooms.
- Antibiotic resistance in the marine environment.
- Fish health understanding of gill health, especially impact of climate change and early diagnosis.
- Understanding of climate change on shellfish and seaweed sectors.
- Work done on health & welfare of farmed fish could be used to help wild fish if we can find a way to gather required data.
- Environmental issue of pharmaceuticals and fish health – options of vaccines, chemical treatment and biological controls. Norwegian project investigating impact of pathogens in closed contained systems.
- Global assessment of sustainability of aquaculture (not specific for Scotland)

Discussion points

- Science updating takes significant time, effort and resource.
- Need vibrant research environment investigating improvements as well as impacts, recognising importance of aquaculture. Other countries have better government involvement in supportive research environment. Focus on best practice and positive outcomes for society and environment, without holding on perpetually to precautionary principle.
- Conversely, a community member reflected that lack of certainty being discussed suggested precautionary principle should be used/ moratorium until more data is collected? Another participant responded that significant and valuable data exists – there will always be unknowns.
- Collaborative pooling of resources to address priority areas and research gaps. E.g. mechanism of Scottish Aquaculture Research Forum (now disbanded)
- Use long-term datasets more appropriately
- Funding opportunities noted as challenging, particularly for 'stepping outside the box' and multidisciplinary research.
- Independence and trust of science noted as important (e.g. reliance on industry modelling – one community commissioned its own modelling at cost with differing outputs). Independent science body should deliver evidence base.
- Discussion around antibiotic use and disagreement on scale of issue in aquaculture. Regulators noted they are seeking to publish antibiotic data in the future.
- More holistic approach to use of science in regulatory framework would be beneficial – e.g. medicines currently regulated on individual basis – we should be considering overall benefits to fish and environment.
- Not enough open debate about data or science, some stakeholders try to shut down discussion on contentious issues.
- Data is not only source of information – inclusion of stakeholder opinions are also important.
- Marine management needs to be science-led, not politically led.

- Scientific data for consenting mainly point-source and should incorporate cumulative and holistic data.
- National Marine Planning – growth targets for sectors included but not environmental carrying capacity. Realistic targets for marine special planning need to be determined & Scotland needs to decide on priorities for marine economy – work together to ensure healthy marine environment.
- Data access and storage – currently have a siloed approach and we need to centralise / create data repository. Huge volumes of data created by new techniques (e.g. eDNA). Issues of cost and ownership.
- Scotland’s aquaculture website holds a lot of basic data and could be expanded.

4. How do you think climate change (CC) (and policies being implemented to manage it such as offshore windfarms) is impacting (or is likely to impact) on the areas where aquaculture is practised?

- CC impacts are concerning e.g. rising water temps affecting fish health, mortality, disease, Emerging pathogens – farmed fish like other farmed animals are more vulnerable. Incl. jellyfish and harmful algal blooms.
- Increasing storm effects, sea level rise, impacts on containment. Sector will need to adapt to prevent escapes.
- As fish diseases get worse this means more chemical treatments with environmental impact.
- Concern around protecting carbon habitats.
- CC weakening wild salmon populations in turn increasing potential impacts from anthropogenic pressures, incl. aquaculture.
- Sea-lice cycle shorter at higher water temp. – implications for farmed & wild fish health welfare.
- Understanding of CC impact on natural fish populations still evolving. CC could influence availability of species to harvest. Also need to understand how these changes impact interactions between farmed & wild fish.
- Stormy seas increase challenge of harvest and deployment.
- Air fouling and increasing fresh water quantities.
- Global patterns of food production will change – Scotland will be required to produce more variety of sustainable protein – for itself and export where CC has impacted production.
- Variability as important as overall direction of change. Data availability increasing at micro-macro level (e.g. 24-7 water temps at farms). Need long-term data sets to inform ongoing work.
- Spatial squeeze – offshore sector and aquaculture less likely to interact. Spatial squeeze for aquaculture associated with inshore space / Highly Protected Marine Area delivery for example.
- Cables from offshore wind (grid connection) is increasing challenge and could impact on inshore aquaculture. Including electromagnetic impacts on shellfish and juvenile fish growth – not enough scientific understanding of how sectors interact.
- Concern with speed of installation of offshore windfarm infrastructure & different approach to consenting – less precautionary?
- Interest in aquaculture’s role in delivering circular economy.

- Technology can play a role in future of aquaculture production.
- As pests increase sector needs to use alternative methods for treating fish, away from chemical use – chem use may reduce resilience of ecosystem.
- Aquaculture & offshore sector should pool data, resources and strategic questions – entire blue space should be looked at. Lessons learned between sectors as they increasingly share space.
- Human piece also needs to be examined - how humans react to environment and new tech – public used to be opposed to wind farms, now accepted as part of landscape.
- A suggestion was made that community perspective is broader than developers realise – not always binary.
- Information on CC impacts and associated issues should be put in public domain – Improve knowledge accessibility to help communities engage, reduce contention and develop consensus. Similar issues in other sectors.
- Learning how to put evolving information into the context of risk assessments. An approach of deploy and monitor, used for offshore wind, is one way to deal with uncertainty of Climate change impacts. We can use strategic environmental assessments and sectoral marine plans.
- Flexible approach to regulation needed that embraces capacity for science to mitigate impacts of climate change – e.g. co-location of renewable energy and aquaculture infrastructure. Rigid approach prevents environmental sustainability.
- Better ‘control’ data needed and more monitoring along west coast – to understand change in ‘normal’ over time. ‘Personal’ observations hard to link to hard data. Including holistic / coastal and terrestrial input. Who pays for this? Government seen as having obligation here.
- All users of marine environment should be considered when measuring impacts – others not as heavily regulated or implicated – aquaculture an easy target compared to e.g. CC/ land use and perceived as getting blame for wider impact. Cultural element as some sector impacts more generally accepted as part of ‘culture’. Need holistic blue economy approach.
- Ecosystem-approach in changing climate must leave space for ecosystem – ‘spatial squeeze’ – cumulative impact of different sectors using same space combined with climate change – will areas left for aquaculture continue to be appropriate? Co-location may be needed.
- Need to understand extent of co-location / co-dev of aquaculture and wind farms. One group noted sector has issues relating to insurance, ownership and responsibility meaning they are not looking to overlap at the moment.

Break-out discussions 2:

1. What are the priority actions needed to improve trust between aquaculture stakeholders?

- Interface is community interacting with farm applications. Community engagement can come across as a box-ticking exercise – not genuine concern from CEOs.
- Approach by fish-farming companies and expectation of right to development was queried. E.g. developers assume local support though provide little employment – e.g. recent opinion poll on proposed farm showed 60% opposition.

- Views are heavily entrenched and will not easily change.
- Consistency of information submitted by sector as a whole would help communities understand different perspectives.
- Practices of engagement/consultation should be consistent, repeatable, reliable
- Industry should stop appealing against planning decisions
- More honest media output.
- Acceptance by industry on where we are on social and environment aspects, in addition to consideration of economic angle. Admission on problems caused by sector and signs of progress made (REC committee recommendations) without 'greenwashing'
- Lay out issues surrounding question of feed (wild fish harvest) to improve trust incl impact of aquaculture compared with other food production – discussion noted that feed of other livestock production not similarly scrutinised – need new science to take collective approach on how to produce food.
- Requirement to educate public to understand aquaculture– in local areas on benefits and costs of individual developments. In schools. General ocean literacy. TV-programmes about farms and farmers, noting challenges of working in aquaculture. Visits t farms an important step.
- Access to information, transparency and opportunities to participate are important to communities. Also raised was accessibility to people who can contextualise information e.g. regulators.
- Consultation currently set up as adversarial framing – created polarisation in aquaculture development. Unhelpful to group people as one camp vs. the other.
- Current distrust based on previous behaviours of some stakeholders.
- Need to think about how regulatory framework operates from community perspective, not just stakeholders. Local communities have strong role but process currently does not allow voices to be heard. E.g. coastal communities not represented in Scottish Aquaculture Council. eNGOs need stronger voice in fora and behaviours should be conducive to collaboration.
- Consent challenges include time to process complex info and how alternatives are presented.
- More consensus on an overall spatial framework ('master plan') could mean less contention over individual development decisions.
- Planning consent currently issued permanently, which means all weight behind one determination – no long term view or opportunity for check-points to gain consent.
- The way that science is used and how that feeds into regulation has problems that need addressed. Scientific process has significant flaws. Poor quality science is used inappropriately – we need accuracy and that science isn't taken as gospel.
- Push from Crown Estate Scotland and Marine Scotland to develop sector but lack of action to apply that e.g. steering group only meeting once a year.
- Role of accreditation – suggestion that more meaningful and stringent requirements from accreditors are needed (e.g. ASC, RSPCA etc)

2. What are the priorities for improving access to data on aquaculture in Scotland?

- Several groups discussed the need to focus on not just access but how data will be used – i.e. communicating what results mean. How data could be used, how it

should not be used. Concern about sharing data without context – needs to be digestible, meaningful and in context to lead to better understanding.

- Lots of data collection in marine science that does not necessarily focus on what is going to happen to data or interpretation. Example initiative from offshore wind to store data gathered in data centres to make it easier to share.
- Improving 'access' also means having data all in one place, in comprehensive and understandable format and accessible to various levels of knowledge. Suggestion that providing background to information helps e.g. demonstrating why data is reported and what it means.
- Communities and eNGO highlighted need to access data and understand it effectively- e.g. community councils to make decision.. Access to best available data and independent advice important. E.g. to fully understand impact of water pollution. But it is often in different places and incomplete. Challenging to find all data for one site – currently presented by topic. Challenging to piece together data & not all publicly accessible.
- Sector representatives queried whether other food producers output data at farm level, stressing need to contextualise data while agreeing there is a need for openness and transparency. Also reflection that discussion needs to be put into context of how much data is already available.
- While not everyone can agree on interpretation of the data some suggested agreement around how it is presented – e.g. more holistic information for geographical area, including agricultural run-off, pollution, plastics. E.g. SG interactive marine plan.
- Scotland's Aquaculture Website helpful, but needs more work – does not provide access to all information. E.g. EIA information not available on interactive National Marine Plan – regulator noted commercial sensitivities relating to EIA, but information is valuable and should be shared.
- Data needs to be formatted to allow interrogation by tools such as artificial intelligence. Lots of different valid questions can be asked from all sectors, if we have a platform where we can access and tools to interrogate.
- Also need to address future requirements of data reporting in context of regulatory framework around value chain that aquaculture sits in i.e. targeted presentation.
- We have to decide collectively who are the opinion formers that conclude what the science is telling us - move away from opinion and towards fact led by evidence and science.
- To improve data sharing from/ between industry need a data holding arrangement and a trusted broker – Sustainable Aquaculture Innovation Centre (SAIC) could be trusted broker.

3. Which types of forum have worked best for enabling dialogue between stakeholder groups?

- There should be an opportunity for regulators and others to feed into science needs, to build trust. This has been lost. Regulators could more clearly communicate evidence gaps and priority focus areas.
- Should be an agreement of priority list of science required for Scotland. Scotland produces world-leading science.

- Independent scientific forum needed to allow conversation about the science with scientists.
- Scientific forum would be exclusionary and not help societal debate. Issue about communication of science and its independence. People select from available science to find arguments supporting their world-view, dissemination is not enough. Using system such as IPCC scale to provide confidence limits could help communication.
- A number of participants flagged need for safe space for difficult discussions – Some noted that such a space should have cross-sector expertise, tasked objectives, clear mandate and should not be a one-off.
- Groups should be solutions-focused with agreed targets and actions. Familiarity and trust important.
- Important not to aim for perfection first time – focus on incremental improvement, continued dialogue, and adaptation.
- Importance of clear terms of reference and remit – expectations need to be clear from the start and ultimate decision-making roles respected. Having clear focus can help move away from antagonism.
- Tension between transparency and trust – some expect quick progress, but familiarity trust and transparency takes time.
- Issues must be brought into the open – hidden lobbying not conducive to collaboration. More time-consuming to identify and be honest with issues but very important.
- Context-dependent – some areas where this type of forum (i.e. virtual round table) works well, in others smaller, more focused groups work better.
- Good cross-section of representation useful, though sometimes should be narrower. Sometimes a technical focus can help.
- Bilateral sub-groups can be necessary to thrash out issues bilaterally and come back to main group.
- Independent hosts – discussions outside of sector useful to avoid accusations of bias. Use of professional, independent facilitators.
- Community engagement needs to start from day 1 and sector needs to be open to greater discussion.
- Avoiding social media is important as it polarises and depersonalises discussion.
- Use of online fora helpful as not always possible for all sub-sectors to get together under one roof.
- Humanising discussion and finding common ground is important. Thought needed on methods of how to run an event. E.g. participants need to be seen as ‘informed citizen’ rather than defined by job or role.
- How well-informed are participants? Ocean literacy and education is key. Sector are opening doors to visitors to try to improve understanding.
- Participants should be open-minded and able to empathise with other views / willingness to have difficult discussions outside of comfort zones.

Examples of what works well:

- Loch Roag management group established following SIWG to build relationships and trust– working well now.

- Salmon Interactions Working Group (SIWG) - Bringing variety of views together to find consensus on way forward.
- Community representative flagged good working relationship with SEPA who have hosted fora including people on all sides. SEPA listen constructively and use information in decision-making, even if we don't like decisions being made.
- We have good dialogue with the aquaculture operators in our area, keeping those groups small has worked well for us.
- Cross-sector discussions have improved – more listening between different disciplines aiding understanding.
- A number of representatives flagged the SSAC virtual round table as useful and would like to see similar moving forward. Some noted preference for face to face.
- Sustainable Aquaculture Innovation Centre has been effective at bringing the sector together and has become a forum where science, Government and industry can work together.

4. What are priority questions that social science could be addressing to help with regulation?

- Natural capital approach – should be assessing social, economic and environmental factors and placing value – to better quantify impacts, benefits and costs. / Undertake economic risk assessment of aquaculture at a national level.
- Others noted such assessment shouldn't be siloed - all food production should be considered holistically (e.g. 70-80% of land in Scotland dedicated to agriculture). Need to understand broad context and provide broad data /evidence. We all eat, we all have impact.
- Migration to rural areas for employment in aquaculture / benefits to society should be studied.
- Idea for research would be comparisons of social views/ dynamics across different aquaculture countries.
- Understand how to encourage sectors to collaborate e.g. offshore energy, fishers, aquaculture within spatial planning work. Alignment of focus. Network group to create liaison could be helpful.
- Identify process of bringing disciplines together to encourage interaction, quantify results. This is not easy – need process to identify priorities.
- Should include assessment of social value of particular decisions.
- Could social science give clear expression of how to use precautionary principle properly? / Use of best available information. PP has lost its meaning, re-establish sensible way of using it. Detrimental impacts may not be obvious but data should still be collected (e.g. sea-lice, interactions). Other participants supportive of adaptive management - allows monitoring and refining of results, not avoiding risk taking, to make sure we continue to evolve.

A number of groups discussed developing social licence to operate, and community engagement

- Discussion around 'social licence' as an additional consent – suggestion it should be granted by Marine Scotland?
- Social licence comes from community acceptance of industry, so who is that community? Need to clearly identify and understand views of wider community, not

just loudest voices. Do we treat all voices equally/ are all equal? How do we capture local /regional opinions? Using a Delphi Method approach could be of use.

- Discussions around opposing views- some flagged strong opinions coming from second home owners/ those who are not in the local community. Others suggested this perspective is overplayed and stakeholders who oppose aquaculture living in communities should not be villainised for expressing concerns. Recognition of extreme views on both sides and need for public understanding.
- Benefits (provided by Crown Estate) should bring environmental and economic benefits to communities, which align with local need.
- Communities should consider environmental, social and economic sustainability (currently focused on environmental) – this would provide a clearer social licence to operate.
- Social license is a broad concept, beyond just a regulatory decision. It's an area where democratic experiments, such as citizen assemblies, could be a good thing. Equip people with the information they need to make a sensible and holistic decision.
- We need to move on from 'stakeholders' to communities and theorise 'trust' as social capital within and between communities – social licence to operate is to strengthen local bonding capital. Research ways to increase 'bridging capital' between opposing view-points. Also need to think about bridging urban and rural communities.
- A key question is: how do we improve the debate and make it more balanced and conducive to better decision-making at individual and organising level? One recent approach is called 'inoculating' people against misinformation.
- The current planning regime emphasises positions that are in opposition. How do you bring people together who don't want to talk to each other? What kind of setting can encourage positive behaviour? 'Fragmented landscape' needs to be addressed to bring people together.
- Reform of public functions needed? Aquaculture system is reflection of wider societal organisation and discourse. Can we bring in reforms to local Government or community councils, so that they can have more decision-making powers and get involved in dispute resolution? Example given of Norwegian system of local governance.
- There needs to be a process that helps achieve consensus e.g. DIPSA process is used by European Environment Agency for these challenges.

- Don't entirely agree that we listen to public and find a majority view. We need to define the way society can value biodiversity and determine if there is a public long-term view of whether biodiversity is crucial to future society. We don't have a clear way of posing that question.
- What is mechanism to understand what wider society wants from marine development? National Marine Plan too industry-focused. Analysis of interactivities between sector and communities.